SCROLL AND MANUFACTURE METHOD THEREOF

Field of the Invention

The present invention relates to a scroll for scroll compressor, particularly a low-cost and highly efficient scroll for scroll compressor.

Background of the Invention

Traditionally the orbiting and stationary spirals in scroll compressor are made of metal. As shown in Fig. 1, the noise and vibration are large while the metal orbiting spiral 10 is orbiting around the metal stationary spiral 20, they wear each other, and they even seize each other in compression process. To eliminate such defects, normally some certain measures are applied in their mechanism for drawing back from each other axially and radially, i.e., providing axial and radial compensation. However, this requires a very complicated mechanism. While the orbiting spiral 10 is orbiting around the stationary spiral 20, the lateral contact force of the vortex line relies only on the peripheral centrifugal force of the orbiting spiral 10, such a contract force is very small. Moreover, because these two spirals contact each other linearly, as shown in point A in Fig. 1, it is hardly to provide a satisfactory sealing effect, leakage may happen easily. Therefore, there are extremely high requirements for the precision of vortex line, wall thickness, height, top and bottom leveling, perpendicularity of vortex wall surface and bottom. The precision has a decisive effect to the scroll compressor's performance and efficiency. Thus, there have been continuous efforts to enhance and assure such precision, but the enhancement of such precision involves production costs and performance requirement of machine tools. On the other hand, deformation caused by heat and external force during the orbiting makes such high precision meaningless. Therefore, normally the optimal geometric shape tolerance is 8 to 15 μm ("Volumetric Compressors Handbook", edited by Yu Yongzhang, published by Beijing Mechanical Engineering Publication, October 2000). Such a high precision requires the use of highly precise machines, tools and chucks, and only some special machinery can meet such requirements. Furthermore, after machining the vortex, surface-hardening treatment is required, such as anodic oxidation, nickel-phosphor plating, nitrogen permeance treatment and the like. All these have made the production of scroll compressors difficult, the cost of production high, but the performance is poor, and it is hard to promote application of scroll compressors extensively.

Summary of the Invention

The main objective of the present invention is to provide a scroll for scroll compressor and its manufacture method. Through change on materials for making the scroll, two spirals composing the scroll contact each other surface to surface, provide a good sealing effect, and eliminate the need of axial and radial compensation because of the properties of the materials used. Use of such materials also lowers noise and vibration during orbiting, makes the spirals highly wear resistant, and extends their service life. Consequently, the requirement for precision and geometric shape tolerance is lowered, the production cost can be lowered.

The scroll according to the present invention comprises an orbiting spiral and a stationary spiral each composed of a spiral body and a corresponding base plate. One of these spirals made of metal, while the other is made of non-metal material with elastic and plastic property. The properties of such materials provide a good sealing effect and eliminate the need of axial and radial compensation during orbiting.

In the present invention, either the orbiting or the stationary spiral is made of metal, while the other is made of elastic and plastic non-metal material.

The spiral body for one of these spirals has a frame.

The said frame is made of porous sheet, either metal or plastic porous sheet.

The frame and the base plate can be formed as an integrated part.

The said non-metal material can be either engineering plastic product, or phenolic resin or epoxy resin.

The scroll manufacture method according to the present invention includes the following steps:

- making spiral bodies with sheet;

- fixing each spiral body to a metal base plate; and

- coating the outer surface of each spiral body and the bottom of each metal base plate contacting with the spiral body with an elastic material, or forming thereon a plastic layer by molding.

The aforesaid elastic material is either polytetrafluoroethylene, or polyurethane or synthetic rubber.

Another scroll manufacture method according to the present invention includes the following steps:

- coating the sheet with elastic material;

- making spiral bodies; and

- fixing each spiral body to a metal base plate.

Another scroll manufacture method according to the present invention includes the following steps:

- Forming of a frame for spiral body on each metal base plate by molding; and

- Coating the frame and the metal base plate with elastic material, or forming thereon a plastic layer by molding.

The fourth method for production of the scroll according to the present invention includes forming of a scroll on a metal base plate with elastic material by molding.

According to the present invention one of the spirals is made of metal, while the other spiral is made of elastic and plastic material. While the orbiting spiral is orbiting around the stationary spiral, the elasticity and plasticity of one of these spirals cause the spirals to contact each other surface to surface instead of linear contact in the prior art. Such a design provides a sealing effect by deformation of the material due to squeezing effect, extends the geometric shape tolerance, such as to about 100 μm, without scarifying the required performance and efficiency, and eliminates the need of a complicated axial and radial compensation process due to their deformation and expansion at high temperature. Moreover, as these spirals can be made by molding, complicated machining and surface hardening are not required, the hardness of an oxidized layer formed on the surface of the spirals formed by molding is higher than that achieved by surface hardening treatment. On the other hand, as one of the spirals is made of hard material, while the other is made of soft material, noise and vibration are relatively low during orbiting; their wear resistance and their service life are improved, and requirement for precision and tolerance of geometric shape is lowered. Consequently, their production cost is lowered.

Brief Description of the Drawings

Fig. 1 illustrates orbiting of an orbiting spiral around a stationary spiral in the prior art.

Fig. 2 is a sectional view of an orbiting spiral according to the present invention.

Fig. 3 is a sectional view of a stationary spiral according to the present invention.

Fig. 4 is a sectional view of a frame for the stationary spiral according to the present invention.

Fig. 5 is a sectional view of the stationary spiral after it is coated with elastic material.

Fig. 6 is a sectional view illustrating the structure of the frame for the stationary spiral integrated with the base plate according to the present invention.

Fig. 7 is a sectional view illustrating a structure of a molded spiral body for the stationary spiral according to the present invention.

Fig. 8 illustrates orbiting of the orbiting spiral around the stationary spiral according to the present invention.

Fig. 9 illustrates the axial compensation between the orbiting spiral and the stationary spiral.

Detailed Description of the Preferred Embodiment

Please refer to Figs. 2 and 3, the scroll according to the present invention comprises an orbiting spiral 1 and a stationary spiral 2. The orbiting spiral 1 is composed of a spiral body 12 and a base plate 11. The stationary spiral 2 is composed of a spiral body 22 and a base plate 21. The orbiting spiral 1 is made of metal, and the stationary spiral is made of elastic and plastic non-metal material.

As shown in Figs. 4 and 5, the stationary spiral body 22 has a frame 23 with a plurality of pores 24. The base plate 21 connected to the frame 23 is formed with a plurality of pores 25. The outer surface of the frame 23 and the bottom 26 of the base plate 21 connected to the frame 23 are coated with an elastic material 3, or formed with a plastic layer by molding.

Please refer to Fig. 6, the spiral body 22, the frame 23 and the base plate 21 composing the said stationary spiral 2 can be formed as an integrated part.

Please refer to Figs. 2 through 5 for a method to make the scroll according to the present invention. The spiral body 22 is made of metal sheet with a plurality of pores 24. The spiral body 22 is fixed to a metal base plate 21. The outer surface of the spiral body 22 and the

bottom of the metal base plate 21 connected to the spiral body 22 are coated with an elastic material 3, or formed with a plastic layer by molding. The pores 24 formed on the sheet can increase the bonding strength of the coating material to the sheet.

The said non-metal material can be polytetrafluoroethylene, PU (polyurethane) or synthetic rubber.

Please refer to Fig. 6 for another method to make the scroll according to the present invention. The spiral body 22 and frame 23 are made by molding as an integrated part, and then the frame 23 and the metal base plate 21 are coated with an elastic material, or formed with an elastic layer by molding.

Please refer to Fig. 7 for another method to make the scroll according to the present invention - the spiral body 22 is formed with an elastic material by molding on the metal base plate 21 directly to complete a scroll 2.

Please refer to Fig. 8 for orbiting of the orbiting spiral 1 around the stationary spiral 2 according to the present invention. The orbiting spiral 1 is contacting with the stationary spiral 2 at a contact surface B on a surface-to-surface manner. As the stationary spiral 2 is made of elastic and plastic material, the squeezing and deformation effect of the elastic and plastic material achieves the sealing effect, eliminates the need of axial and radial compensation, and simultaneously lower the requirement for precision and geometric shape tolerance of the scroll, and consequently lower its production cost.

Please refer to Fig. 9, which illustrates the orbiting of the orbiting spiral 1 around the stationary spiral 2 according to the present invention, axial deformation happens on the orbiting spiral 1 and the stationary spiral 2 due to the effect of an external force, high temperature, squeezing and deformation, as shown in the locations C and D, and eliminates the need of axial and radial compensation.

As described above, according to the present invention one of the spirals is made of metal, while the other spiral is made of elastic and plastic material. During the orbiting the elasticity and plasticity of one of these spirals cause the spirals to contact each other surface to surface, provide a sealing effect by deformation of the material due to squeezing effect, eliminate the need of a complicated axial and radial compensation because there is a deformation and expansion at high temperature. Moreover, as one of these spirals is made of hard material, and the other is made of soft material, noise and vibration are relatively low during orbiting; their wear resistance and their service life are improved, and requirement for precision and tolerance of geometric shape is lowered. Consequently, their production cost is lowered.